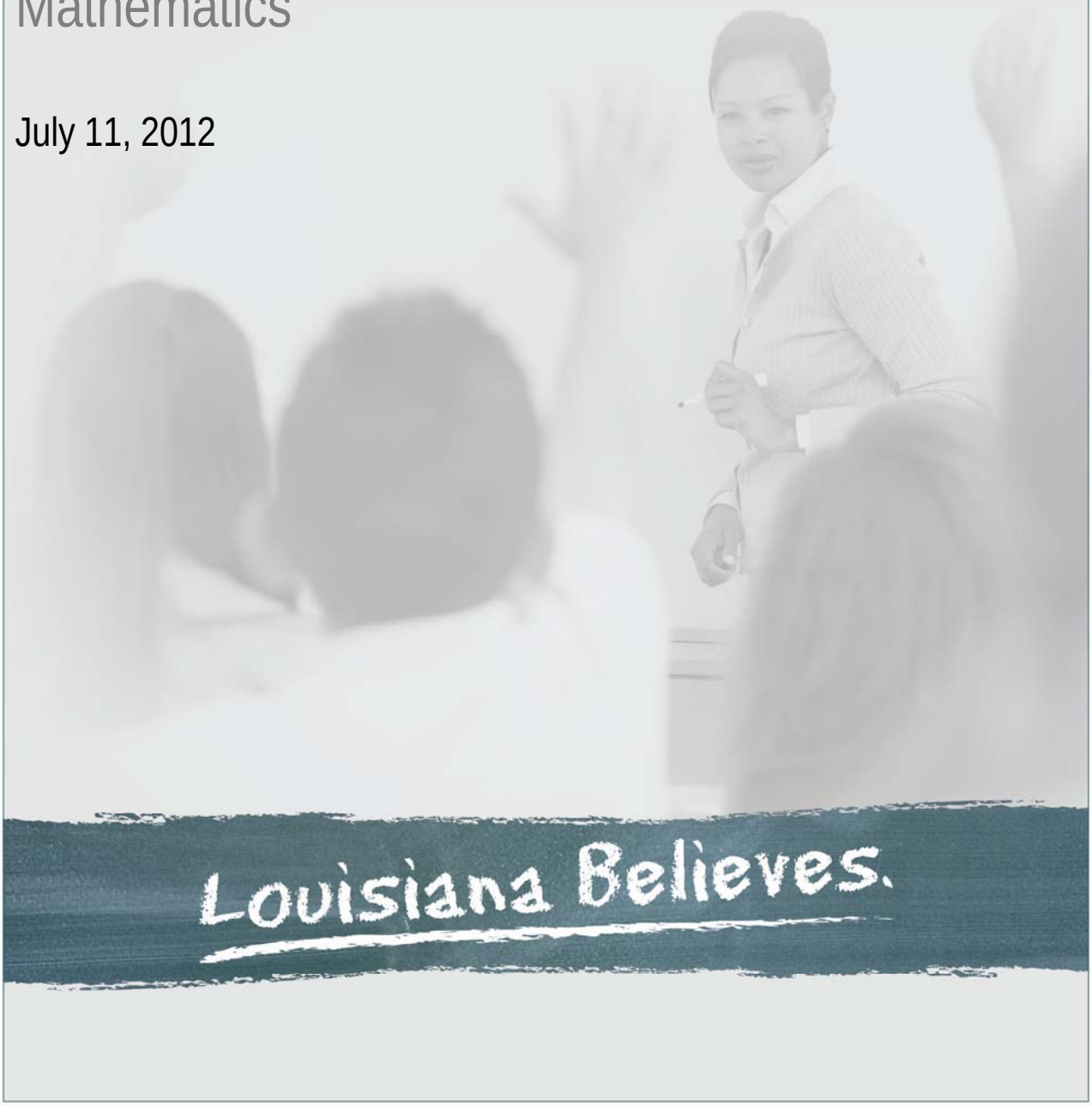
# Preview of Common Core State Standards Sample EAGLE Items

## Grade 9

## Mathematics

July 11, 2012



## Grade 9

Technology-enabled, extended-response item types provide an opportunity for multiple solution methods, long chains of reasoning, and connection to many of the practices. This item type can be very effective in showing whether students can solve in-depth problems independently and in showing their preferred solution methods.

The first item in this set is a scaffolded item that guides the student through the practice of creating and refining a mathematical model (MP.4). Students create a model and then use it and write about it. The item assesses abstract and numeric reasoning (MP.2) and the ability to develop an argument (MP.3). By requiring the student to use the technology enhancement of a graphing tool to plot points and draw a line of best fit, the item aligns more closely to the content standard than a multiple-choice item that assesses recognition, yet it retains the option for machine scoring. This item type is designed to give the teacher substantial information about a student's knowledge and skills in relating data to a linear equation. The item also reinforces good mathematics instruction rather than test-taking strategy.

The second item assesses the student's ability to solve a formula for a variable, an important skill in chemistry and physics. The constructed-response format obviates the common multiple-choice test-taking strategy of eliminating wrong answers and thus provides a clearer picture of the student's ability to solve equations without numbers through abstract reasoning (MP.2).

The third item scaffolds the practice of constructing viable arguments (MP.3) by asking students to describe their problem-solving process and the purpose of each step. By incorporating a decimal multiplier, the equation encourages students to look for structure (MP.7) and to multiply by 4 or 100 rather than automatically distributing to remove parentheses.

The fourth item in this set requires students to evaluate a given quadratic function (A.CED.1) in terms of a given situation. Students must recognize how the standard equation can be used to model the situation (MP.4). In the process of solving the quadratic equation, students must use quantitative reasoning (MP.2) to substitute the correct values. Students must make use of the given equation and a calculator (MP.5) in order to solve the problems.

The fifth item is similar to the first item in focusing on modeling data with a linear equation, but it assesses additional practice standards by providing little scaffolding. Students need to make sense of the problem (MP.1), reason abstractly (MP.2), and use appropriate tools such as a calculator. By asking students to write a report about their method and results, the problem encourages students to work toward constructing viable arguments (MP.3).

| UIN: | E19001 | Subject: | Math | Grade: | 9 | Item Type: | CR |
|---|---|---|---|---|---|---|---|
| CCSS: | A-CED.2 | Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. | | | | | |
| Practice Standard(s): | | 2. Reason abstractly and quantitatively.<br>3. Construct viable arguments and critique the reasoning of others.<br>4. Model with mathematics | | | | | |

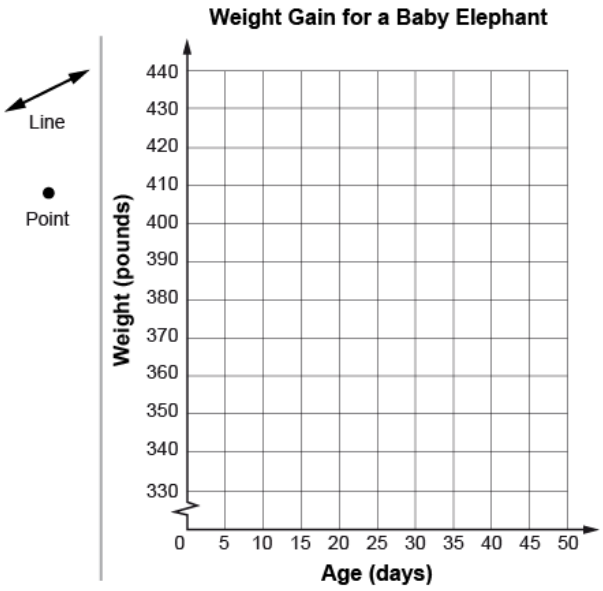
| MC Key: | NA | Item Name: | elephant growth | Calc | C | Est. Difficulty: | M | MC Key: | |
|---|---|---|---|---|---|---|---|---|---|
| Points: | 0–6 | Accommodations: | | Scoring Method: | | Mixed | | | |
| Passage Title(s): | | | | | | | | | |
| Source info: | | | | | | | | | |

Andy found data on the Internet showing the weight of a baby elephant in a zoo at various ages.

| Age (days) | 2 | 7 | 26 | 35 | 68 | 500 | 697 | 910 | 1,164 |
|---|---|---|---|---|---|---|---|---|---|
| Weight (pounds) | 340 | 356 | 407 | 431 | 504 | 1,550 | 1,910 | 2,288 | 2,891 |

Help Andy develop a model that can be used to predict the elephant's weight for other ages where there is no data. Complete the five steps below.

1. Use the point tool to plot the first four data points on the graph. Then use the line tool to draw a line of best fit.




2. Determine the equation of your line of best fit as an initial model for the elephant's growth.

- Use *x* to represent the elephant's age.
- Use *y* to represent the elephant's weight.
- Start your equation with *y* = .

| Enter your equation in the space below. |
|---|
| *y* = |

3. Use your equation to predict the weight of the elephant at 68 days.

| Predicted weight of elephant at 68 days = | |
|---|---|

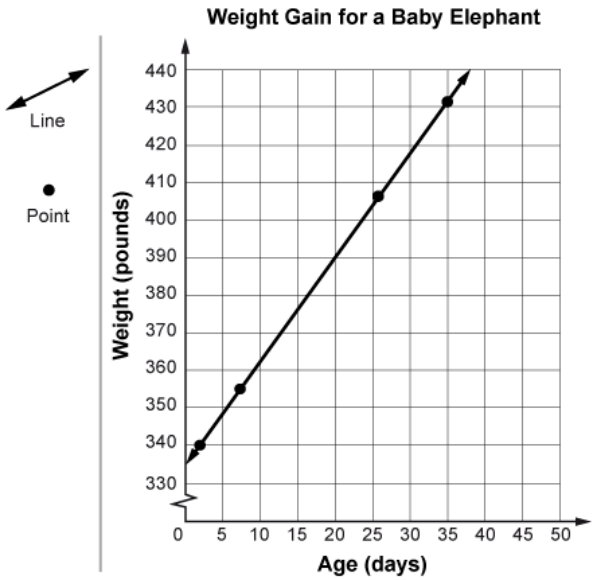
4. Compare your prediction with the actual weight of the elephant at 68 days. Describe how your model should be changed to generate more accurate predictions when the elephant is older.

5. Describe, in terms of the elephant's growth, why your initial model did not work for all the data.

**Rubric**

Exemplary Responses

1.




2. $y = 2.76x + 335$

3. 523 pounds

4. Actual weight was 504 pounds; model predicted too great a weight, so the slope should be decreased.

5. As the baby elephant got older, it grew a little more slowly on average than it did during the first 35 days.

Scoring Notes

Step 1: An error range for plotting points and drawing the line needs to be established.
Step 2: An error range for the slope and *y*-intercept needs to be established. If the line drawn in Step 1 is incorrect, student can receive credit for either the correct equation or the equation matching the line they drew.
Step 3: This value needs to match the equation given in Step 2.
Step 4: This answer needs to be based on the answer given in Step 3.
Step 5: This answer needs to be based on the answer given in Step 3.

Points Assigned

Step 1: 2 points; 1 point for correctly plotting the data; 1 point for drawing the trend line
Step 2: 1 point for an acceptable equation
Step 3: 1 point for a correct prediction using the equation
Step 4: 1 point for correctly comparing the prediction with the actual value
Step 5: 1 point for an adequate description of why the initial model did not work perfectly

Scoring Rubric

| Score | Description |
|---|---|
| 6 | 6 points |
| 5 | 5 points |
| 4 | 4 points |
| 3 | 3 points |
| 2 | 2 points |
| 1 | 1 point |
| 0 | The student's response is incorrect, irrelevant, too brief to evaluate, or blank. |

| UIN: | E19002 | Subject: | Math | Grade: | 9 | Item Type: | CR |
|---|---|---|---|---|---|---|---|
| CCSS: | A.CED.4 | Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.* | | | | | |
| Practice Standard(s) | | 2. Reason abstractly and quantitatively | | | | | |

| MC Key: | | Item Name: | Ideal Gas Law | Calc | CN | Est. Difficulty: | M | DOK | 2 |
|---|---|---|---|---|---|---|---|---|---|
| Points: | 2 | Accommodations: | | Scoring Method: | | AS | | | |
| Passage Title(s): | | | | | | | | | |
| Source info: | | | | | | | | | |

**Use the Ideal Gas Law to answer the question.**

$$PV = nRT$$

The Ideal Gas Law allows engineers to model aspects of gases at ordinary temperatures ($T$) and pressures ($P$). In the equation, $V$ represents the volume of the gas, $n$ represents the number of moles of the gas, and $R$ is a constant.

**Part A**

In order to use a computer to rapidly calculate temperature changes in a gas as the pressure and volume change, an engineer needs to solve the gas law equation for $T$.

Solve the Ideal Gas Law for $T$.

$T =$

**Part B**

Another engineer wants to compute changes in the volume of a gas sample as the pressure changes.

Rewrite the Ideal Gas Law in a form that would **best** help this engineer.

**Rubric**

Exemplary Responses

**Part A**

$$T = \frac{PV}{nR}$$

**Part B**

$$V = \frac{nRT}{P}$$

Points Assigned

- 1 point for solving the equation for *T*
- 1 point for solving the equation for *V*

Scoring Rubric

| Score | Description |
|---|---|
| 2 | 2 points |
| 1 | 1 point |
| 0 | The student's response is incorrect or blank. |

| UIN: | E19003 | Subject: | Math | Grade: | 9 | Item Type: | CR |
|---|---|---|---|---|---|---|---|
| CCSS: | A.REI.1 | Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. | | | | | |
| Practice standard(s): | | 2. Reason abstractly and quantitatively.<br>3. Construct viable arguments and critique the reasoning of others.<br>7. Look for and make use of structure. | | | | | |

| MC Key: | | Item Name: | solve an equation, show process | Calc | CN | Est. Difficulty: | M | DOK | 2 |
|---|---|---|---|---|---|---|---|---|---|
| Points: | 3 | Accommodations: | | Scoring Method: | | AS | | | |
| Passage Title(s): | | | | | | | | | |
| Source info: | | | | | | | | | |

**Use the equation to answer the question.**

$0.25(y - 2x) + 4 = 12$

Solve the equation for $y$ one step at a time.

Show each step in the table, describe the process, and explain the purpose of that step.

The first step is already done. You may not need all the rows, but you must show at least two more steps.

| Solution Steps | Process | Purpose |
|---|---|---|
| $0.25(y - 2x) + 4 = 12$ | Given | |
| $0.25(y - 2x) = 8$ | Subtract 4 from each side | Combine like terms |
| | | |
| | | |
| | | |
| | | |

**Rubric**

Exemplary Responses

| Solution Steps | Process | Purpose |
|---|---|---|
| $0.25(y - 2x) + 4 = 12$ | Given | |
| $0.25(y - 2x) = 8$ | Subtract 4 from each side | Combine like terms |
| $y - 2x = 32$ | Multiply both sides by 4 | Remove the parentheses |
| $y = 2x + 32$ | Add 2x to both sides | Isolate y |
| | | |
| | | |

Points Assigned

- 0–2 points for correct solution steps (other solutions are possible)
- 0–2 points for matching process to solution steps (even if part of the solution is incorrect)
- 0–2 points for purpose statements if they match the process statements

Scoring Rubric

| Score | Description |
|---|---|
| 3 | 6 points |
| 2 | 4 to 5 points |
| 1 | 2 to 3 points or demonstrates minimal understanding of solving equations |
| 0 | The student's response is incorrect, irrelevant, too brief to evaluate, or blank. |

| UIN: | M190010 | Subject: | Math | Grade: | Alg I | Item Type: | CR |
|---|---|---|---|---|---|---|---|
| CCSS: | A.CED.1 | Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. | | | | | |
| Practice standard(s): | | 2. Reason abstractly and quantitatively.<br>4. Model with mathematics.<br>5. Use appropriate tools strategically. | | | | | |

| MC Key: | | Item Name: | Rock from a bridge | Calc | C | Est. Difficulty: | M | DOK | 2 |
|---|---|---|---|---|---|---|---|---|---|
| Points: | 2 | Accommodations: | | Scoring Method: | | AS | | | |
| Passage Title(s): | | | | | | | | | |
| Source info: | | | | | | | | | |

A boy throws a rock straight down off a bridge that is 150 feet above a river. The initial downward speed of the rock ($v_0$) is 24 feet per second.

The formula for the height of an object in free fall is $h = -16t^2 - v_0t + h_0$, where height ($h$) is measured in feet and time ($t$) in seconds.

**Part A**

How far will the rock fall in 1.5 seconds?

**Part B**

How long will it take the rock to hit the river?

**Rubric**

Exemplary Response

**Part A**

| |
|---|
| 72 feet |

**Part B**

| |
|---|
| 2.4 seconds |

Points Assigned

- 1 point for the correct distance in part A
- 1 point for the correct time in part B

Scoring Rubric

| Score | Description |
|---|---|
| 2 | 2 points |
| 1 | 1 point or demonstrates minimal understanding of using a quadratic equation to solve problems |
| 0 | The student's response is incorrect, irrelevant, too brief to evaluate, or blank. |

| UIN: | E19005 | Subject: | Math | Grade: | 9 | Item Type: | CR |
|---|---|---|---|---|---|---|---|
| CCSS: | F-LE.2 | Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). | | | | | |
| Practice standard(s): | | 1. Make sense of problems and persevere in solving them.<br>2. Reason abstractly and quantitatively.<br>3. Construct viable arguments and critique the reasoning of others.<br>5. Use appropriate tools strategically. | | | | | |

| MC Key: | | Item Name: | Cliff erosion | Calc | C | Est. Difficulty: | M | DOK | 2 |
|---|---|---|---|---|---|---|---|---|---|
| Points: | 3 | Accommodations: | | Scoring Method: | | mixed | | | |
| Passage Title(s): | | | | | | | | | |
| Source info: | | | | | | | | | |

You are an engineer hired by the state parks service to analyze a trail that runs along an eroding cliff. The parks service wants to know how soon the edge of the cliff will erode to within 5 meters of the trail.

A geologist collected the data shown in the table from careful measurements of satellite photos.

| Year | Distance from Trail (meters) |
|---|---|
| 1985 | 20.50 |
| 1990 | 19.75 |
| 1995 | 19.00 |
| 2000 | 18.25 |
| 2005 | 17.50 |

**Part A**

Use the geologist's data to develop an equation that models this situation. Use *D* for distance and *T* for time.

**Part B**

In 2012, a careful measurement shows the cliff edge is now 16.40 meters from the trail.

Write a brief report to the parks service explaining

1) the meaning of your equation in part A in terms of the situation,
2) your prediction of the year the cliff edge will reach a distance of 5 meters from the trail,
3) how you determined the date in your prediction, and
4) how reliable you think your prediction is and why.

**Rubric**

Exemplary Responses

**Part A**

D = -0.15(T - 1985) + 20.50

**Part B**

The mathematical model I developed predicts that the cliff will erode an average of 15 centimeters a year based on the geologist's data.

Plugging a distance of 5 meters into my equation, I then solved for T and got a date of 2088.

5 = -0.15(T - 1985) + 20.50

0.15(T - 1985) = 15.50

T - 1985 = 103.3

T ≈ 2088

My prediction should be accurate. When I put T = 2012 into my equation, the result was 16.45 meters, a difference of only 5 centimeters from the actual measurement.

Score Notes

Part A: Other solutions are possible such as having *T* = years since 1985.

Part B: Student should both show work and explain the model.

Points Assigned

- 1 point for writing a correct equation in part A
- 0–2 points for a holistic judgment of the student's solution and explanation in part B

Scoring Rubric

| Score | Description |
|---|---|
| 3 | 3 points |
| 2 | 2 points |
| 1 | 1 point or demonstrates minimal understanding of creating and applying linear equations |
| 0 | The student's response is incorrect, irrelevant, too brief to evaluate, or blank. |